

## GUIDE FOR UTILIZATION OF CENTRAL OFFICE LOOP EXTENDERS

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#### FIGURE 1

#### 1. GENERAL

1.1 This section provides REA borrowers, consulting engineers, contractors, and other interested parties with technical information for use in the design and construction of telephone systems. It discusses in particular a new family of solid state devices for extending the signaling range of central office subscriber loops. These devices are called loop extenders to distinguish them from conventional long line adapters which employ relays and provide pulse correction in their operation.

1.2 Loop extenders acceptable to REA extend the signaling range of central office equipment and also supply the additional voltage to obtain the necessary transmitter current for proper operation of the telephone instrument. These devices can be used in many applications instead of conventional long line adapters. Their detailed technical characteristics are covered in REA Specification PE-61, "REA Specification for Central Office Loop Extenders." This specification covers requirements for signaling, supervision, voice frequency transmission, longitudinal balance, lightning protection, alarm features, environmental operating conditions, etc. Loop extenders meeting this specification are included in the "List of Materials Acceptable for Use on Telephone Systems of REA Borrowers."

1.3 Some of the advantages of loop extenders over conventional long line adapters are a marked reduction in cost, even in small quantities, a considerable reduction in mounting space, a savings in maintenance costs, reduced circuit outages due to solid state techniques, and better transmission characteristics.

1.4 The subscriber loop voice frequency transmission design is the same as when conventional long line adapters are used. This design is set forth in REA TE & CM 424, "Design of Two Wire Subscriber Loop Plant," and REA TE & CM 427, "Application and Use of Voice Frequency Repeaters for Subscriber Loops." Loop extenders as discussed herein are mounted in central offices and connected between line equipment and voice frequency repeaters. This is shown in Figure 1..

## 2. METHOD OF OPERATION

2.1 Most loop extenders increase the signaling and supervision range of central offices by increasing the voltage on a per line basis. They are d.c. to d.c. converters, powered from the central office battery, which supply a floating voltage in series with the central office battery voltage on the tip and ring conductors of the subscriber's loop. They also provide reverse battery to the loop when answer supervision occurs.

2.2 Unlike the long line adapter, the loop extender does not provide pulse correction and supervision from an especially designed sensitive relay. Therefore, its operation and range are dependent on the capabilities of the particular central office to which it is connected.

## 3. APPLICATION INFORMATION

3.1 The d.c. resistance of the loop is one of the important parameters to be considered in the application of loop extenders. The following resistance ranges include the telephone instrument:

Central Office Loop Limit Guaranteed by Manufacturer	Loop Limit Capability When Equipped With Extender
1900 ohms	4500 ohms
1500 ohms	3500 ohms
1200 ohms	3200 ohms

3.2 When loop extenders are to be used other important parameters should also be followed:

3.21 Line Leakage Resistance - It should not be less than 100,000 ohms as measured between conductors or from either or both (conductors in parallel) conductors to ground. This is consistent with present recommendations for conventional long line adapters with booster battery.

3.22 Subscriber Application - Loop extenders should not be used with more than four parties on a line. The ringers should be bridged, limited to six, and ringing frequencies below 20 cycles should be avoided. Divided ringers should be avoided if at all possible to minimize unbalanced longitudinal currents which could create noise. If divided ringers cannot be avoided, contact the loop extender supplier for his recommendations.

3.23 Induced Voltage to Ground - Loop extender applications should be limited to loops that have no more than three volts of induced a.c. from tip and ring to ground as measured in the talking condition at the central office. This limit on a.c. influence may be high for most cable plant applications, but is needed because solid state signaling devices may generate noise in the presence of excessive induced a.c. voltages.

3.24 Type of Wire Plant - Since loop extenders may be sensitive to induced a.c. voltages and plant unbalances, they should be used only on all-cable plant or plant which uses only short sections of open wire at the subscriber end of the cable.

3.25 Automatic Number Identification Arrangements (ANI) - All loop extenders will operate with the circle digit type of ANI. Some types will work with other ANI methods while other types will not. If applications other than circle digit ANI or single party service are contemplated, the loop extender supplier should be contacted for the latest information.

3.26 72 V or 96 V Operation - Loop extenders inserted in loops of 3000 ohms or less should be arranged for 72 volts across Tip and Ring, whereas loops in excess of 3000 ohms should be arranged for 96 volt operation. This arrangement, recommended by manufacturers of these devices, minimizes dial pulse distortion. Do not use loop extenders where they will work on loops less than 1000 ohms as there is a possibility of poor dial pulsing and instability.

3.27 Pushbutton Dialing Telephones - Loop extenders as described herein may be used on loops where telephones are equipped with pushbutton or rotary dials.

3.28 Trunks Employing Inband Signaling - The pulsing, supervision and ring trip capabilities of most central offices permit the use of battery boosting techniques without jeopardizing signaling performance. Where loop extenders are used in central offices with

trunks employing inband signaling arrangements, however, it is necessary to install pulse correction in the outgoing trunk circuits on the M lead of the signaling unit. This is due to the rather narrow range of percent make - break pulsing distortion which can be accepted by many inband signaling units, plus the fact that loop extenders do not have pulse correcting capabilities. This same restriction applies to other long loop signaling techniques which do not employ pulse correction.

3.29 Protection Considerations - The application of an elevated line-to-ground voltage may cause gas tube arresters to hold over after breakdown on a lightning surge. It is, therefore, necessary to check hold over characteristics of gas tubes which may be used along the line.

#### 4. WHEN TO USE LOOP EXTENDERS OR OTHER DEVICES

4.1 Loop extender usage is governed in general by economic as well as technical considerations. Their application is usually most economical on a per line basis where a relatively small percentage of the total loops require loop extenders. If a large percentage of the loops connected to a switchboard are beyond the normal range of the switching equipment, it may be more economical to consider other loop extension techniques such as "Common Mode Operation" (REA TE & CM-331), "Station Carrier" (REA TE & CM-911), "Constant Current Operation, etc.

4.2 Conventional long line adapters may still be more satisfactory for certain applications. These would include loops beyond the range of loop extenders as given in Paragraph 3.1. They would permit the design of loop plant to 4500 ohms without regard to the signaling limit of the particular central office equipment serving the area. There are other situations where the loop plant might include open wire party line end sections in sparsely settled areas where pulse correction may be required because of outside plant conditions or special switching considerations. Another possible application is for situations where severe induction from power systems may make it necessary to employ long line adapters for proper pulsing or minimizing noise generation in the loops.

#### OF LOOP EXTENDERS

signaling range of loop dial trunks may extenders. The reverse battery supervision the same as for subscriber loops. More be requested from the manufacturer of the

5.2 Paystations - Paystations of the semi-postpay type may be extended to the range listed in REA TE & CM-703, "Paystation Services," for various booster supplies. The manufacturers of loop extenders should be contacted for possible applications with other types of paystations.

Figure 1

